SECTION 59

FRESH WATER SYSTEMS

59.1 REFERENCES

(59A) UNITED STATES PUBLIC HEALTH SERVICE (USPHS) - *Handbook on Sanitation Of Vessel Construction*

(59B) CENTER FOR DISEASE CONTROL (CDC) - *Recommended Shipbuilding Construction Guidelines for Cruise Vessels To Call on U.S. Ports*

(59C) UNIFORM PLUMBING CODE (UPC)- Section 1.11

(59D) Code of Federal Regulations - 46 CFR Sub-chapter F

(59E) **VOLUME V**, *OWNER - FURNISHED EQUIPMENT*

(59F) R.W. FERNSTRUM® GRIDCOOLER® - *Installation and Maintenance Form 160*

59.2 INTRODUCTION

This Section describes the Contractor Design and Provide general requirements for the fresh water systems that consist of hot and cold potable water supply to plumbing fixtures and equipment, potable water filling and transfer, fresh water sanitary flush water, potable water disinfecting treatment, and machinery cooling.

For WSF Fleet-wide Standardization purposes, End No. 1 of the Vessel shall always be considered the bow, and this designation shall delineate port and starboard, fore and aft wherever they are addressed in the Technical Specification.

59.3 GENERAL

BE ADVISED: The Contractor is reminded and advised that POTW system installations, such as POTW fills and freshwater/POTW cross-connections will require inspection and approval by the USPHS/FDA, and issuance of Certificates of Sanitary Construction (CSC) to WSF. It is paramount that the Contractor employ craft persons with prior understanding of the applicable health rules and regulations, and prior installation experience in such installations, to facilitate an installation that meets the design, rules, and regulations for such installations.

The design shall provide that all fresh water stored be potable water, in lieu of separate grades of potable and wash water. For the purposes of these requirements, potable water shall be as defined by Reference (59A). All systems shall meet the requirements of this and all other Sections of the Technical Specification, and References (59A) through (59E).

All potable water and fresh water systems shall be equipped with pressure displays, pump status indicators, pushbutton operators, and low pressure alarms at the EOS and as described in Section 99 of the Technical Specification. The pressure gage shall be mounted on a gage board in the EOS in a location as approved by the WSF Representative. The pushbutton operators shall be located on the EOS Control Console in a location approved by the WSF

Representative. See Section 85 of the Technical Specification. See Section 91 of the Technical Specification for additional requirements.

See Section 73 of the Technical Specification for the general requirements for potable water and fresh water pumps. See Section 74 for general piping and material requirements. See Section 75 for insulation and lagging requirements.

For WSF Fleet-wide Standardization purposes, unless specifically specified otherwise, all heat exchangers shall be ALFA-LAVAL, stainless steel, plate type units. These exchangers are available through ALFA TEC Inc., Mr. Kevin Oakley, (206) 281.9250

For WSF Fleet-wide Standardization purposes, unless specifically specified otherwise, all keel coolers shall be 90/10 copper-nickel R.W. FERNSTRUM and Co. GRIDCOOLER®, series and style as specified. These keel coolers are available through R.W. FERNSTRUM and Co., Mr. Frank Bjorkman, (906) 863.5553. ***All keel cooler installations shall be provided with protective grille guards on the hull which allows for the removal of the keel cooler assembly as approved by the manufacturer and the WSF Representative***. See the *General – Grid Cooler Installation* Subsection below.

As a design **ALTERNATIVE** to the potable water and plumbing drain systems, as set forth in the Technical Specification, WSF will entertain an arrangement during the Phase II Technical Proposal stage of this Contact which provides for a Potable Water Storage Tank and Sewage Holding Tank on each End of the Vessel as set forth as an alternative in the *GENERAL* Subsection in Section 11 of the Technical Specification.

59.4 POTABLE WATER STORAGE TANKS

Provide two (2) 8,000 gallon independent storage tanks for cold potable water as set forth in Section 78 of the Technical Specification.

59.5 POTABLE WATER SERVICE SYSTEM

All tanks, piping, fixtures, pumps, etc., through which potable water can flow, or is stored, shall be cleaned and disinfected in accordance with this Section and Sections 74 and 101 of the Technical Specification.

59.5.1 Functional Requirements

The potable water service piping system shall meet the following functional requirements:

A. Permit transfer of potable water from shore to each storage tank, from tank to tank and from each tank back to shore.

B. Provide storage tanks for 16,000 U.S. gallons of potable water using two (2) tanks (8,000 gallons @ 95% each).

C. Provide continuous hot and cold potable water service to sinks, showers, Food Vending area equipment, and other service points throughout the Vessel, including freeze-proof outlet cold water hose bibbs on the Navigation Bridge Deck (six (6) each end), Sun Deck (eight (8)), Passenger Deck (four (4)), Upper Vehicle Deck (two (2) each side), Rescue Boat Stations (one (1) each), and Lower Vehicle Deck (six (6) each end) for housekeeping purposes. In addition, each Engine Room shall have two (2) hot water and two (2) cold water hose bibbs, and each Tank Room and Reduction Gear Room shall have one (1) hot water and one (1) cold water hose bibb. Provide continuous hot and cold potable water to the Oily Water Separator as set forth in Section 70 of the Technical Specification.

D. Provide continuous fresh water service to the flushing system.

E. Provide for the utilization of shore-side pressurized potable water through the fill lines for a temporary source of water to the potable water system, in the event that both potable water tanks are empty, or both potable water pumps are shut down.

The system shall be complete with cutout valves and any appurtenances necessary to permit the filling and re-circulation operations without impairing delivery of water at a minimum pressure of forty (40) psi at the weather deck hose connections and twenty (20) psi at all plumbing fixtures. Where the manufacturers of specific fixtures or equipment normally recommend higher inlet pressures than those cited above for their manufactured item, the manufacturers' recommended inlet pressures shall be provided. All pressures cited herein shall be achieved with the system operating at design capacity.

59.5.2 Piping Configuration and Components

Potable water system branches and loops shall be configured with due regard to limiting adverse effects on services should a particular section need to be isolated for maintenance or repair. The system shall be subdivided near amidships into two (2) main branches, forward and aft, with isolation of each branch possible for maintenance, without disrupting service to the other branches.

A high level of system isolation shall be provided, with all system branch and loop connections to the main potable water headers having readily accessible isolation stop valves.

The potable water system shall be designed to eliminate water hammer, including hammer within branches with quick-closing or self-closing valves. Air chambers and similar fittings that may lose their hydraulic cushioning feature because of the absorption of the air by water are not acceptable.

Potable water piping shall not be run through bilges, or over electrical cabinets and equipment as set forth in Section 87 of the Technical Specification.

Vents from each Potable Water Storage Tank shall be provided with a TATE ANDALE, flanged, #52-90F, or equal, vertical vent check valve, without flame barrier and with a 16 mesh screen that discharges out through the curtain plate on the Lower Vehicle Deck so that any overflow from a storage tank during filling operations will pass overboard and not onto the Vehicle Deck.

All piping exposed to the weather shall have means for isolation and draining to prevent freezing.

Hose bibbs for the Rescue Boat stations shall be located inside the Rescue Boat enclosure near the engine end of each Rescue Boat.

Locations for all Vehicle Deck hose bibbs shall be such as to prevent damage by vehicles.

All hose bibbs, and faucets at cleaning gear and mop sinks shall be provided with an approved vacuum breaker.

Provide one (1) McMASTER-CARR Auto-Rewind Wall-Mount Hose 'n Reel assembly #7138T12, or equal, with ⅝"-50' hose in each Engine Room. Installation shall include a piping, fittings, supply vacuum breaker, and root ball valve. Location shall be determined by the WSF Staff Chief Engineer.

Each lavatory in the public restrooms shall be provided with a proximity type sensor controlled faucet to reduce water consumption. Each faucet bank in the Passenger Deck Restrooms shall be provided with an automatic hot/cold water mixing valve to deliver warm water at the faucet. Each faucet in the Sun Deck level public restrooms shall be provided with an automatic hot/cold water mixing valve to deliver warm water to the faucet. Each sink in the Crew accommodation areas, Crew Shelter, and Dayrooms shall be provided a single handle type faucet. Each drinking fountain, each coffee maker, Dayroom sink faucet, and Crew Shelter sink faucet supply shall be fitted with replaceable activated carbon water filters in an accessible location.

Two (2) identical potable water pumps, PACO LC, or equal, centrifugal type; shall be provided, installed in parallel, each taking suction through strainers from a manifold connected to the potable water tanks and discharging to a single bladder type pressure tank. The pressure tank shall be connected to a common service main feeding various services. The manifold arrangement shall allow either pump to transfer from one tank to any other. These pumps shall be located adjacent to the bladder tank and in close proximity to the potable water storage tanks. There shall be a valved quick disconnect fitting installed on the bladder tank to allow for the addition of compressed air for purposes of "charging" the bladder tank.

The EOS shall be equipped with potable water service pressure displays, pump status indicators, pushbutton operators, and low pressure alarms to meet the requirements of Section 99 of the Technical Specification. The pressure gage shall be mounted on a gage board in the EOS in a location approved by the WSF Representative. The pushbutton operator, indicators, and switch for selecting the lead and lag potable water pumps shall be located on the EOS Control Console in a location as approved by the WSF Representative. See the *GENERAL* Subsection in Section 85 of the Technical Specification.

There shall be two (2) adjustable pressure switches for cut-in/cut-out of the potable water pumps. The switches shall be arranged so that either pump may be arranged to be the "lead" or "lag" pump. A manual switch shall enable the operator to select the desired pump to be the "lead" or "lag" pump, and should not require readjustment of the pressure switches when switching pumps. The switch shall also enable the "lag" pump to be used automatically in the event that there is enough of a pressure drop in the pressure tank due to excessive volume demand on the system. Each pump shall be sized to handle the total capacity of the system.

Each plumbing fixture shall be fitted with cutout valves in the supply and return lines so that water service can be secured at the fixture for maintenance, repair or replacement of the fixture.

59.5.3 Hot Water Service Sub-system

The hot potable water sub-system shall consist of a single plate type heat exchanger, two (2) electric hot water storage tank/heaters and one (1) circulating pump, PACO LC, or equal, centrifugal type. The hot potable water subsystem shall provide water at 130F degrees from each fixture within 10 seconds of opening the fixture. Hot water shall be supplied at a minimum temperature of 130F degrees and a maximum temperature of 140F degrees at all showers, sinks, lavatories, and other services requiring hot water. ***Where these requirements cannot readily be met by reconfiguring the loop routes in way of particular branches or fixtures, low volume, fast recovery electric re-heaters may be installed in the branch or at the fixture to meet the requirements, as approved on a case-by-case basis by the WSF Representative***.

The primary heating source(s) for the water storage tank/heaters shall be hot water from the Hot Water Heating (Waste Heat Recovery) System, supplied by a single, plate type heat exchanger and controlled by 2-way or 3-way modulating, temperature adjustable valves on the primary side of the heat exchanger. These valves shall prevent the flow of hot water into the heat exchanger on the primary side should there be a failure of the sensing element. The plate type heat exchanger shall be of the dual wall design to eliminate the possibility of contaminating the potable water with the hot water heating system water. The two (2) electric hot water storage/tank heaters shall be fitted with electric heating elements, each capable of supplying the total demands of the system.

The EOS shall be equipped with potable water service pressure displays, pump status indicators and low pressure alarms to meet the requirements of Section 99 of the Technical Specification.

59.5.4 Fill and Transfer Subsystem

This sub-system shall be capable of filling the storage tanks by receiving potable water from the shore. The sub-system shall also be capable of discharging water from the storage tanks back to shore. Transfer piping used shall be a minimum of three (3) inches. All tank filling piping shall be a minimum of four (4) inches.

Two (2) deck connections, each consisting of a kamlock fitting, shall be located on the port and starboard sides of the main deck in locations reasonably accessible for connection to shore hoses. Four (4) inch "lockable" kamlock fittings shall be installed at least twenty-four (24) inches above the deck in a protected location with the hose connection turned down.

For WSF Fleet-wide Standardization purposes, the End No. 1 POTW fill station shall be on the port side, the End No. 2 station shall be on the starboard side.

A relief valve shall be installed between the filling and service mains to protect the service system when it is being supplied from shore. The relief valve shall be set at five (5) psig above potable water pump shutoff pressure.

Provide a tank level overflow alarm with "RED" indicating lights at each POTW fill station on the Lower Vehicle Deck to indicate when the POTW tanks are in an overflow condition. The light shall mimic the alarm status as displayed in the AMS ("RED" flashing – alarm condition, "RED" solid – alarm acknowledged but high level still exists, "RED" off – alarm has reset or does not exist).

59.6 SANITARY FLUSHING SYSTEM

The Sanitary Flushing System shall utilize fresh water supplied from the Potable Water Service System through a USPHS approved backflow prevention device. The sanitary flushing system shall provide water to the following fixtures and services: water closets, urinals, and fresh water makeup and fills for all machinery and systems.

The Sanitary Flushing System shall be sized to deliver water at a minimum pressure of forty (40) psi at the weather deck hose connections and a minimum of twenty (20) psi at all plumbing fixtures. Where the manufacturers of specific fixtures or equipment normally recommend higher inlet pressures than those cited above for their manufactured item, the manufacturers' recommended inlet pressures shall be provided. All pressures cited herein shall be achieved with the system operating at design capacity.

NOTE: Consideration of pressure droops caused by simultaneous flushing of water closets and urinals shall be incorporated into the system design so as to provide adequate flushing water supplies to all fixtures.

Sanitary flushing system branches and loops shall be configured with due regard to limiting adverse effects on services should a particular section need to be isolated for maintenance or repair. The system shall be subdivided near amidships, forward and aft, with isolation of each branch possible for maintenance, without disrupting service to the other branch. Individual isolation valves shall also be provided for each of the following flushing water zones; ***1).*** Crews' Quarters, ***2).*** Officers' Quarters, ***3).*** water closets above the Passenger Deck End No. 1, and ***4).*** water closets above the Passenger Deck End No. 2.

A high level of system isolation shall be provided with all system branch and loop connections to the main flushing water headers provided with readily accessible isolation stop valves. Each plumbing fixture shall be fitted with cutout valves in the supply line so that water service can be secured at the fixture for maintenance, repair, or replacement of the fixture.

The flushing system shall be designed to eliminate water hammer, including hammer within branches with quick-closing or self-closing valves. Air chambers and similar fittings that may lose their hydraulic cushioning feature because of the absorption of the air by water are **not acceptable**.

All piping exposed to the weather shall have means for isolation and draining to prevent freezing.

Urinal flushing in the Men's Restroom for both the urinal trough and the ADA urinal shall be accomplished as set forth in Section 20 of the Technical Specification.

The flushing on the individual water closets shall be accomplished as set forth in Section 20 of the Technical Specification.

59.7 SEWAGE HOLDING TANK AND TRANSFER LINE FLUSHING SYSTEM

There shall be a Hi-Fog Sprinkler/Fresh Water Back-flushing Tank and pumping system for the purpose of flushing the sewage shore discharge line after pumping off sewage, for wash-down of the sewage holding tanks, and also for freshwater supply to the Hi-Fog water mist system (see Section 13 of the Technical Specification).

The Hi-Fog Sprinkler/Fresh Water Back-flushing Tank shall be an independent tank with a nominal capacity of 4,500 gallons as set forth in Section 78 of the Technical Specification. The tank shall be automatically filled with fresh water from the discharge line of the sanitary flushing system, via a level controlled solenoid valve.

There shall be a Fresh Water Back-flushing pump CARVER, or equal, for the purpose of sewage line flushing and sewage tank wash-down. The pump shall have a nominal capacity

of 200 gpm and shall be remotely controlled from both the sewage pumping station on the LVD and from the EOS. The Fresh Water Back-flushing pump suction shall be located at a height in the Hi-Fog Water Mist System/Back-Flushing FW Storage Tank to allow for the minimum of reserve water volume, as required by the Hi-Fog Water Mist Suppression System. There shall be an alarm signal into the AMS system should the water level drop below the required minimum point.

Provide, at a minimum, two (2) LECHLER GYRO™ Tank Washing Nozzles (Product Code 577.359.17.BN), or equal, 360° spray angle, 1-inch nozzle inlet connection, flow rate of 75 gallons per minute at 40 psi, for each sewage holding tank. The tank washing nozzles shall be mounted through flanged ports in the top of each sewage holding tank, such that the nozzle can be removed from the tank and the tank opening blanked without sewage leaks. Provide piping, isolation and check valves to hookup flushing water to the nozzles. Water for tank wash shall be provided from the Sanitary Flushing System. The valves isolating the sewage tank wash-down nozzles in the sewage tanks shall be capable of being remotely operated from both the sewage pumping stations on the LVD and from the EOS in a location as approved by the WSF Representative. See the *Sewage Holding Tanks* Subsection in Section 70 of the Technical Specification.

The Fresh Water Back-flushing pump shall also be connected into the Firemain to allow for freshwater wash-down of the Vehicle Decks and freshwater flushing of the Firemain and Vehicle Deck Sprinkling Systems after use.

59.8 FRESH WATER COOLING SYSTEMS

59.8.1 General – Grid Cooler Installation

All grid cooler installation designs shall take into consideration the negative effects of parasitic drag due to grid cooler, and guard installations onto the hull. Installation design shall provide an installation that minimizes parasitic drag, protects the grid coolers units from damage, and those specific WSF Fleet unique concerns defined below, while providing adequate cooling as required by each equipment manufacturer's installation requirements during both underway and dock side conditions. Consideration of grid cooler servicing (i.e. inspection, installation, and removal) shall also be considered and addressed in the Contractor's design.

Due to operational concerns unique to the WSF Fleet, all cooler installations shall be provide with substantial 360 degree external guard systems to protect the grid coolers from damage caused by logs, debris, and the effect of anchor chain drag associated with floating dolphins at certain WSF terminals. These floating dolphin anchor chains drag across the hull in certain weather conditions, passing over the grid cooler areas. The Contractors design shall take into consideration these occurrences, and the design shall protect all coolers from damage.

Each grid cooler shall be provide with an isolation valve on the inlet and outlet piping, just inside the hull line. Each isolation valve shall be provide with a remote operator readily operable from the space walkway level. See the *VALVES, FITTINGS AND INSTRUMENT PIPING* Subsection in Section 74 of the Technical Specification for additional remote valve operator requirements.

All grid cooler installation and guard designs shall be approved by the WSF Representative ***prior*** to final cooler selection and installation. WSF will entertain both hull surface and recess type (partial or complete) mount designs, but all installations shall be of the same approved design. Installations shall include all structure, coolers, attachments, anodes, and fittings to produce a complete and operational grid cooler system that meets the cooling requirements of that equipment serviced by the cooler under all operational conditions, whether underway, or dock side. See Reference (59F).

59.8.2 OFE Main Engines

Each Main Engine shall be configured with two (2) independent closed-loop fresh water cooling systems: one (1) high temperature jacket water cooling system and one (1) low temperature charge air (after cooler) cooling system. The Jacket Water Cooling Systems shall utilize FERNSTRUM®; Z-Series, single stack, 2 pass, flanged type keel coolers to reject the heat to the sea. A central hot water heating system shall be provided to utilize waste heat from each Main Engine jacket water cooling system for heating the HVAC system, potable water and Main Engine keep-warm systems.

The Contractor shall size the keel coolers to account for both of the following conditions:

- Each Main Engine operating at 110% overload and moving through the water at seventeen (17) knots, and assuming there is no heat rejection to the primary heat recovery plate heat exchanger.

- Pushing the dock (Vessel stationary) with single engine utilizing 75% of rated horsepower, and bow propeller in “Full Feather” position and bow propeller shaft stationary, and assuming there is no heat rejection to the primary heat recovery plate heat exchanger.

59.8.2.1 Jacket Water Cooling

Each Main Engine fresh water cooling system shall be arranged to be completely independent from other cooling systems to prevent cross-contamination of coolant.

Each Main Engine fresh water cooling system shall include a dedicated plate type heat exchanger to recover waste heat from the engine coolant and transfer it to the

Hot Water Heating System. The hot water heating system shall be fully automatic to the extent that operator assistance is not required to maintain proper diesel engine operating temperatures and recover waste heat when an engine is placed in or taken out of service. An electronic thermostatic control valve shall be provided and installed in the cooling system to mix the coolant returning from the hot water feed heat exchanger (primary) or to the keel cooler (secondary), which are piped in series, to maintain the manufacturer's recommended return coolant temperature back to the engine. For operational and maintenance commonality, the electronic control valve shall be of the same manufacturer (AMOT CONTROLS), and base Model number (GED) as that utilized in the PSI Contractor's SCAC (Separate Circuit After Cooling) design. The thermostatic control valve piping shall be installed so that it may be readily accessed and removed/installed for maintenance.

Circuit Balancing valves shall be provided on the outlet of each keel cooler to allow for balancing of flows, and shall be set for equal proportioning of heat rejection during commissioning. See the *VALVES, FITTINGS AND INSTRUMENT PIPING* Subsection in Section 74 of the Technical Specification for balancing valve indication requirements.

The Jacket Water Cooling System design and installation shall comply with all engine manufacturer requirements to ensure engine performance is not compromised.

Provide and install a non-chemical type water treatment device for the Jacket Water Cooling System to prevent internal corrosion. The device shall be an ELYSATOR T-15 (**NOTE**: ***This device <u>is</u> <u>not</u> a TRIO T-15 as spoken to in the Jacket Water Cooling Subsection below***), complete with flowmeter, air vent, conductivity meter, anode set, inlet/outlet ball valves, and regulating valve (supplied by International Water Treatment North America LLC, 7406-27th St. W #207, University Place, WA 98466, (253) 566-1438), or equal. The device operates in bypass and is provided inlet flow from the discharge side of the Jacket Water Cooling System circulating pumps, with outlet flow to a lower pressure point in the Cooling System. Consult with PSI Contractor to determine appropriate connection points on the Main Propulsion Engine. At commissioning, adjust the flow rate through the device as specified by the device supplier. The Contractor shall consult with the device supplier for maintenance clearance and installation requirements. See the *Jacket Water Cooling* Subsection in Section 60 of the Technical Specification.

59.8.2.2 OFE Separate Circuit After Cooling (SCAC)

The Main Engines shall be configured for separate circuit after cooling (SCAC). Each engine shall be configured with its own dedicated SCAC system. The SCAC system shall be independent of its engine's jacket water cooling system

except that the two (2) systems share in common the same engine accessory rack-mounted expansion tank. One (1) OFE engine driven cooling water pump will be provided for circulating the SCAC cooling water through each engine, Contractor provided external piping and dedicated plate-type heat exchanger.

The SCAC system design and installation shall comply with all engine manufacturer requirements to ensure that engine performance is not compromised.

59.8.3 OFE Ship's Service Diesel Generator

Each Ship Service Diesel Generator engine shall be configured with two (2) independent closed-loop fresh water cooling systems: one (1) high temperature jacket water cooling system and one (1) low temperature charge air (after cooler) cooling system. The Jacket Water Cooling Systems shall utilize FERNSTRUM®; Z-Series, single stack, 2 pass, flanged type keel coolers to reject the heat to the sea.

The Contractor shall size the keel coolers to account for both of the following conditions:

- Each Ship Service Diesel Generator operating at 100% load with Vessel moving through the water at seventeen (17) knots.

- Each Ship Service Diesel Generator operating at 100% load with Vessel stationary and tied up at dock.

59.8.3.1 Jacket Water Cooling

Each diesel generator engine jacket water cooling system shall be arranged to be completely independent from other cooling systems to prevent cross-contamination of coolant. The system shall utilize an engine attached pump. The external piping and keel cooler for each Jacket Water Cooling System shall be adequately sized to keep external resistance to within the allowable levels of the engine attached pump.

The Contractor shall size and install fresh water cooling system auxiliary expansion tanks if, after consultation with the PSI Contractor, the engine attached expansion tanks are not adequate.

The Jacket Water Cooling System design and installation shall comply with all engine manufacturer requirements to ensure that engine performance is not compromised.

Provide and install a non-chemical type water treatment device for the Jacket Water Cooling System to prevent internal corrosion. The device shall be a

stainless steel ELYSATOR TRIO T-15, complete with flowmeter, air vent, conductivity meter, anode set, inlet/outlet ball valves, and regulating valve (supplied by INTERNATIONAL WATER TREATMENT NORTH AMERICA LLC, 7406-27th St. W #207, University Place, WA 98466, (253) 566-1438), or equal. The device operates in bypass and is provided inlet flow from the discharge side of the Jacket Water Cooling System circulating pumps, with outlet flow to a lower pressure point in the Cooling System. Consult with the Ship's Service Diesel Generator Contractor to determine appropriate connection points on the Ship's Service Diesel Generator Engine. At commissioning, adjust the flow rate through the device as specified by the device supplier. The Contractor shall consult with the device supplier for maintenance clearance and installation requirements.

59.8.3.2 Separate Circuit After Cooling (SCAC)

The diesel generator engines shall be configured for separate circuit after cooling (SCAC). Each engine shall be configured with its own dedicated SCAC system, utilizing an engine attached pump. The SCAC system shall be independent of its engine's jacket water cooling system, with the exception of sharing the expansion tank. The external piping and plate-type heat exchanger for each SCAC system shall be adequately sized to keep external resistance to within the allowable levels of the engine attached pump.

The Contractor shall provide and install the temperature regulating device (AMOT Controls), or equal, utilized in a diverting mode on the primary side of the plate heat exchanger to coolant inlet and outlet temperatures at the required settings as specified by the Ship's Service Diesel Generator Contractor.

The Contractor shall size and install fresh water cooling system auxiliary expansion tanks if, after consultation with the PSI Contractor, the engine attached expansion tanks are not adequate.

The SCAC system design and installation shall comply with all engine manufacturer requirements to ensure that engine performance is not compromised.

59.8.4 OFE Emergency Diesel Generator

The OFE Emergency Diesel Generator set installation shall be configured with two (2) independent closed-loop fresh water cooling systems, one (1) for Jacket Water cooling, and the other for SCAC (Separate Circuit After Cooling). The radiator expansion tank is physically divided into two (2) different expansion tanks, and there is no contact between the fluids of each system. The intent of this Work is that the radiator equipment for the closed-loop system shall be installed **remote** to the Emergency Diesel Generator Room. The remote horizontal core, motor driven fan, assembly with optional low-level gage and

switches (2), removable galvanized SEDD (expansion) tank, HERESITE coated core, and galvanized frame shall be delivered as OFE with the generator set and shall be installed by the Contractor in a space served with an access door and motorized supply/exhaust louvers. The generator radiator shall be provided in a separate space in the upper-most portion of the stack funnel, in an area directly above the Emergency Diesel Generator Room, to allow for the exhaust air to be vented out from the top of the stack, and intake cooling air drawn in from the inboard side of the Stack.

The Contractor shall provide and install the temperature regulating device (AMOT Controls), or equal, utilized in a diverting mode on the primary side of the SCAC (Separate Circuit After Cooling) radiator circuit to maintain coolant inlet and outlet temperatures at the required settings as specified by the Ship's Service Diesel Generator Contractor.

The weather louver for the supply to the remote radiator area shall be of a bolt-in type using Type 316 stainless steel fasteners and meet the requirements for louvers in the *Terminals; Diffusers, Grilles, and Louvers* Subsection in Section 12 of the Technical Specification. Sizing of the intake louver assembly in the inboard side of the stack shall be sized to handle the air intake requirements of the radiator fan **and** to allow for passage of the radiator assembly through the opening after the louver is removed, which ever is larger. The louver assembly shall be provided with two (2) permanent lifting padeyes to facilitate lifting/removal without the need to weld temporary padeyes to the louver in the future.

The air discharge vent from the top of the radiator area shall be provided to preclude water, rodents, and birds from entering the area

Provide and install a non-chemical type water treatment device for the Jacket Water Cooling System to prevent internal corrosion. The device shall be an stainless steel ELYSATOR TRIO T-15, complete with flowmeter, air vent, conductivity meter, anode set, inlet/outlet ball valves, electrically operated circulating pump, and regulating valve (supplied by INTERNATIONAL WATER TREATMENT NORTH AMERICA LLC, 7406-27th St. W #207, University Place, WA 98466, (253) 566-1438), or equal. The device operates in bypass and is provided flow from the water treatment device supplier's electrically operated circulating pump. Consult with the Ship's Service Diesel Generator Contractor to determine appropriate connection points on the Emergency Diesel Generator Engine. At commissioning, adjust the flow rate through the device as specified by the device supplier. The Contractor shall consult with the device supplier for maintenance clearance and installation requirements.

Provide a minimum of six (6) padeyes over the remote radiator assembly located to allow for disassembly of the radiator assembly and removal of the radiator. Padeyes shall be as set forth in the *LIFTING PADEYES* Subsection in Section 50 of the Technical Specification.

59.8.5 Auxiliary Cooling Water System

Independent fresh water cooling systems, one (1) per each end of the Vessel, shall be provided to cool the following machinery cooling loops:

- No. 1 End Fresh Water Cooling System: Reduction Gear lube oil, Controllable Pitch Propeller (CPP) hydraulic oil, Main Engine SCAC system, and SSDG engine SCAC systems.
- No. 2 End Fresh Water Cooling System: Reduction Gear lube oil, CPP hydraulic oil, EOS/ Workshop areas air conditioning condenser, Main Engine SCAC system, and SSDG engine SCAC system.

  Each of the above machinery cooling loops shall reject its heat to the fresh water cooling system installed in each End of the Vessel, by means of a plate-type heat exchanger. The plate type heat exchangers shall be supplied with fresh cooling water in a parallel arrangement. Each of the plate type heat exchangers shall be equipped with full-flow ball valves on the inlet side and circuit balancing valves on the outlet side, together with appropriately sized inlet and outlet piping to allow for the proper regulation of flow through the coolers. At commissioning these valves shall be set to allow for proper balance of flow through each of the circuits to allow for proper cooling of connected machinery heat loads. There shall be inlet and outlet thermometers mounted on the fresh water side of each of the plate heat exchangers. Vent lines with isolation valves shall be provided at the high points on discharge side of cooler. See the *VALVES, FITTINGS AND INSTRUMENT PIPING* Subsection in Section 74 of the Technical Specification for balancing valve indication requirements.

The pressure display shall be located on a gage board in a location within the EOS as approved by the WSF Representative. The pushbutton operators and indicators shall be located on the EOS Control Console in a location approved by the WSF Representative. See the *GENERAL* Subsection in Section 85 of the Technical Specification.

The fresh water cooling systems, in turn, shall reject their heat to the sea through dedicated FERNSTRUM®; double stacked, Z-Series, single stack, 2-pass, flange type keel coolers installed in each End of the Vessel.

Two (2) equally sized circulating pumps, PACO LC, or equal, centrifugal type; each capable of supplying the entire cooling water demand, shall be provided for each closed-loop cooling system. The pumps shall be configured in a primary/standby arrangement with automatic startup of the standby pump on low discharge pressure from the primary pump.

In addition to the two (2) main circulating pumps for the End No. 2 fresh water cooling system as outlined above, provide and install one (1) smaller sized circulating pump,

PACO LC, or equal, centrifugal type; of approximately ½ horsepower and pipe it into the fresh water cooling system by an arrangement of check valves, such that a lower flow rate is established through the intermediate system. The purpose of this fractional horsepower pump is to provide a cooling source for the EOS HVAC condenser (see Section 64 of the Technical Specification for the EOS HVAC heat rejection rate and other requirements), while at the same time limiting the amount of electrical load placed on the shore power circuit when the Vessel is in tie-up status.

Provide a non-chemical water treatment devise for each of the two fresh water cooling systems. The treatment device shall be a stainless steel ELYSATOR TRIO T-15, complete with flowmeter, air vent, conductivity meter, anode set, inlet/outlet ball valves, and regulating valve (supplied by International Water Treatment North America LLC, 7406-27th St. W #207, University Place, WA 98466, (253) 566-1438), or equal. The device operates in bypass and is provided inlet flow from the discharge side of the system circulating pumps, with outlet flow to a lower pressure point in the Cooling System. Provide a flow restrictor in the main piping, if necessary, to create the pressure drop required to cause the required flow through the water treatment device. At commissioning, adjust the flow rate through the device as specified by the device supplier. The Contractor shall consult with the device supplier for maintenance clearance and installation requirements.

59.8.6 Jacket Water Holding and Transfer System

Jacket water holding and transfer systems shall be installed for draining all main and generator engine cooling systems during repairs and overhauls. The Emergency Diesel Generator engine shall be provided with valved jacket water drain connection(s) to allow for the draining and refilling of the engine's jacket water to/from a container via gravity drain and pump refill using the "loose" jacket water transfer pump provided below. The connection valve shall be provided with the same valve locking capability as the Engine Room systems, and appropriate kamlock fittings with caps.

Each Engine Room shall have a Jacket Water Holding Tank located below the floor plates to permit both gravity and pump suction drainage to the holding tank and pump suction from the holding tank (for refill purposes), for the Main Engine and Ship's Service Diesel Generator engine cooling systems. These drain systems shall be "hard piped" and manifolded between the engines and the holding tank.

The capacity of the Jacket Water Holding Tank in each Engine Room shall be adequate to contain the jacket water from the Main Engine cooling system in that Engine Room (engine block, piping, expansion tanks and heat exchangers) **and** the jacket water from one (1) of the Ship's Service Diesel Generator engines cooling system in that Engine Room (engine block, piping, expansion tanks and heat exchangers). Tank construction shall be in accordance with the requirements of Section 78 of the Technical Specification.

Two (2) jacket water transfer diaphragm type, air operated, polypropylene center block, Buna-N internal parts, aluminum housing pumps (one (1) in each Engine Room), WILDEN P2 Pro-Flo, or equal, shall be provided and arranged to transfer cooling water from the holding tanks, up through the drain piping to each Main Engine, and to the engine expansion tank and to a Lower Vehicle Deck discharge station. A compressed air connection, with a globe shut-of valve at the hose connecting fitting, for each pump shall be routed to a location near the pump and above the deck plate level to allow attachment of an air supply hose without the need to remove a deck plate nor crawl under the deck plate level.

The transfer piping system suction/discharge valves shall be manifolded. The diaphragm pumps shall be mounted next to the holding tank with all necessary isolation and bypass valving, manifold, and piping. All valves shall be provided with locking devices as set forth in the *VALVES, FITTINGS, AND INSTRUMENT PIPING* Subsection in Section 74 of the Technical Specification. The pump connections to the bypass piping shall be via kamlock connections and flex hoses. Unless approved otherwise by the WSF Representative, access to the pump assembly, manifold, and valving under the deck plates shall be by a single "hinged" deck plate. See **FIGURE 59-1** below:

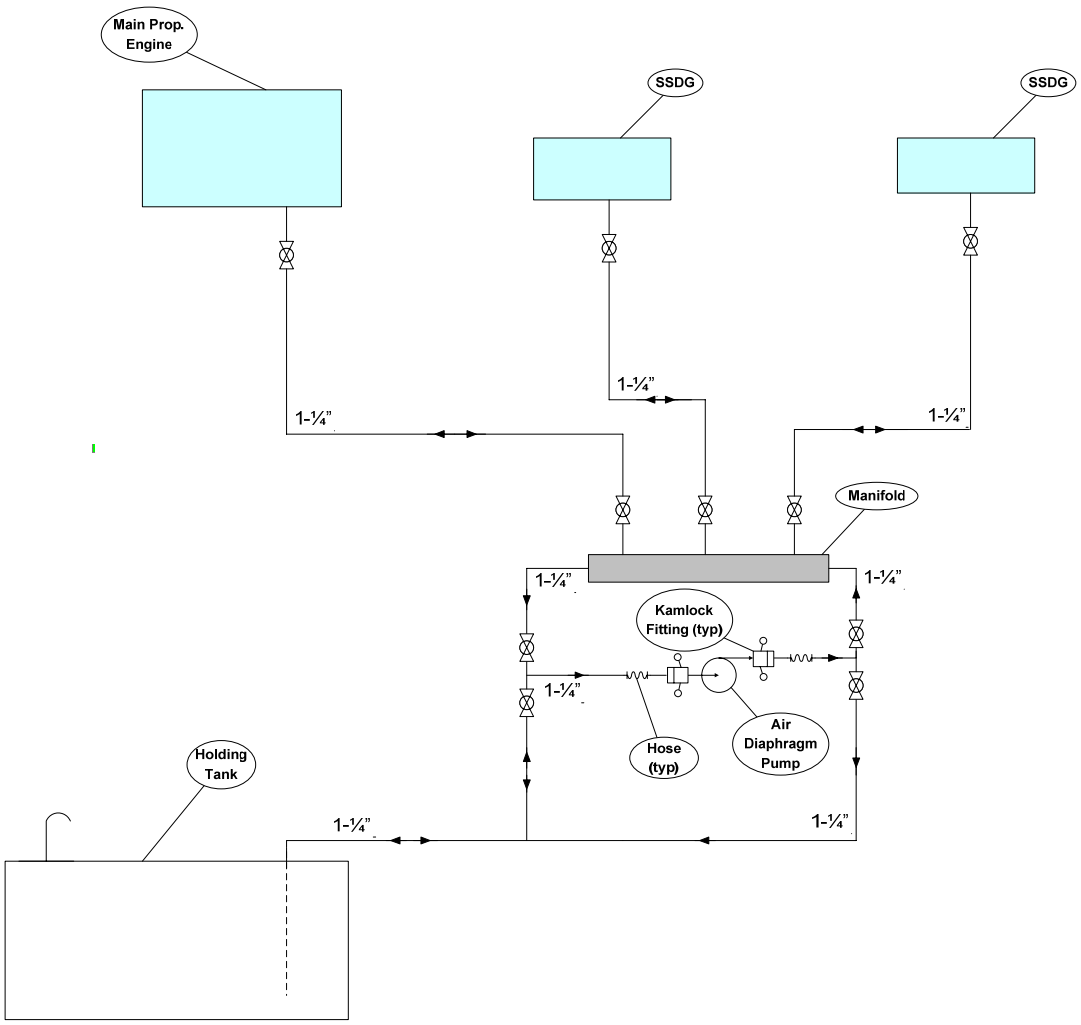

FIGURE 59-1
Jacket Water Manifold Piping Schematic

One (1) additional jacket water transfer pump identical to the above mentioned transfer pumps shall be provided "loose" along with matching kamlock connections (with caps and an air connection). This pump assembly will be for refilling the Emergency Diesel Generator Set during maintenance activities. The pump assembly shall be turn over to the Staff Chief Engineer for storage.

59.9 OILY WATER SEPARATOR SYSTEM

Provide hot and cold water supply to the oil water separator in Engine Room No. 1 as set forth in the *OILY WATER SEPARATOR SYSTEM* Subsection in Section 70 of the Technical Specification.

59.10 CLEANING AND FLUSHING

All piping, piping components and equipment shall be thoroughly cleaned after fabrication and prior to installation.

After complete installation, each system shall be thoroughly cleaned and flushed of all foreign matter with clean fresh water in accordance with this Section and Section 74 of the Technical Specification. System flushing shall be conducted at the system's maximum operating pressure and above normal line velocity.

Prior to flushing operations, pumps, heat exchangers, pressure and flow control valves having in-line mechanisms capable of trapping, and other similar devices capable of being affected by the carryover of foreign matter, shall either be removed or blanked-off and bypassed. Flushing shall be accomplished utilizing pumping devices that do not form a part of any piping system permanently installed in the Vessel.

Temporary basket strainers fitted with basket or cone strainers with 10×10 wire cloth strainers, and magnets, shall be employed throughout the flushing process. System cleanliness shall be evidenced by the basket strainers containing no debris visible to the naked eye after two (2) hours of full flow operation. Except on copper-nickel or copper pipe, pneumatic or electric motor driven line vibrators, of the temporary in-line and/or portable hand types, shall be continuously employed during the cleaning process. The vibrators shall be firmly affixed to the piping throughout the cleaning cycle. Portable vibrators shall be occasionally repositioned during the cleaning process, throughout all accessible portions of the piping. Flux removal, where applicable, shall be accomplished by a twelve (12) hour soak with ambient fresh water followed by either a four (4) hour flush with ambient fresh water, or a one (1) hour flush with 100F degree (plus 30F degrees, minus 0F degrees) fresh water.

59.11 CLEANING AND DISINFECTING

Before being placed into service, the entire potable water system, including the storage and pressure tanks, shall be cleaned, disinfected and flushed in accordance with the requirements of References (59A) and (59B). Should any requirement conflict arise between these two (2) References, the more stringent shall prevail.

Certificates of disinfection shall be provided to the WSF Representative prior to Sea Trials and again prior to the systems being placed in service. The certification shall include laboratory analyses documenting that all bacteria levels are below current local, state, and Federal health agency requirements.

Prior to Sea Trials, the potable water system shall be flushed sufficiently so that the water drawn from all taps and/or faucets is fit for drinking and free from all odor or taste of paint, preservative, and/or disinfectant.

Should it be necessary to re-open the potable water system prior to delivery, the entire system shall be re-cleaned and re-disinfected. New laboratory analyses and certificates of disinfection shall be provided to the WSF Representative. Unless otherwise agreed prior to opening the system, opening, re-cleaning and re-disinfecting shall be completely at the expense of the Contractor.

59.12 SPARE PARTS AND INSTRUCTION MANUALS

Provide a list of recommended spare parts and special tools, for those items that are Contractor furnished, together with parts lists and instruction manuals necessary to maintain and service provided equipment and accessories in accordance with the requirements of Sections 86 and 100 of the Technical Specification.

59.13 TESTS, TRIALS AND INSPECTIONS

Tests and/or trials shall be provided in accordance with this Section and Section 101 of the Technical Specification.

Inspection shall be performed as defined in this Section and Section 1 of the Technical Specification.

59.14 PHASE II TECHNICAL PROPOSAL REQUIREMENTS

The following deliverables, in addition to others required by Section 100 of the Technical Specification and the Authoritative Agencies, shall be provided during the Phase II Technical Proposal stage of Work in accordance with the requirements of Section 100 of the Technical Specification:

A. Piping System Calculations - Potable Water Fill and Transfer System

B. Piping System Calculations - Fresh Water Flushing System

C. Piping System Calculations - Jacket Water Holding and Transfer Systems

D. Piping System Calculations - Machinery Fresh Water Cooling Systems

E. Heat Exchanger Sizing Calculations - Main Engine Jacket Water Hot Water Heating (Waste Heat Recovery) System.

F. Keel Cooler Sizing Calculations - Machinery Fresh Water Cooling Systems.

See Section 100 of the Technical Specification for additional requirements regarding technical documentation.

59.15 PHASE III DETAIL DESIGN AND CONSTRUCTION REQUIREMENTS

The following deliverables, in addition to others required by Section 100 of the Technical Specification and the Authoritative Agencies, shall be provided during the Phase III Detail Design stage of Work in accordance with the requirements of Section 100 of the Technical Specification:

A. Piping System Calculations - Potable Water Fill and Transfer System

B. Piping System Calculations – Fresh Water Flushing System

C. Piping System Calculations - Jacket Water Holding and Transfer Systems

D. Piping System Calculations - Machinery Fresh Water Cooling Systems

E. Heat Exchanger Sizing Calculations - Main Engine Jacket Water Hot Water Heating (Waste Heat Recovery) System.

F. Keel Cooler Sizing Calculations - Machinery Fresh Water Cooling Systems.

See Section 100 of the Technical Specification for additional requirements regarding technical documentation.

(END OF SECTION)